Appendix D Current Meter Calibrations

Two types of electromagnetic current meters were used in the DELILAH array, Marsh-McBirney 551's (Figure 4 in the main text) and Scripps Institution of Oceanography "open frame" sensors (Figure D1). All of the current meters were calibrated in a constant flow tank by the Naval Oceanographic Office in Bay St. Louis, MS. Each instrument was calibrated at five speeds ranging from 0.0 to 1.91 m/s and four probe orientations (± X, ±Y). All instruments deployed during the experiment were also postcalibrated. Because of the biological growth that developed on the open frame current meters, they were post-calibrated with and without the growth. Although the growth had decayed somewhat by the time the instruments were recalibrated, the results give some indication of their performance under fouled conditions. The calibration results, including pre- and postcalibration gains and bias values, and computed changes between the calibrations, are listed in Tables D1 and D2.

Pre- and postcalibrations were used to adjust the collected time series data. In general, the precalibration was used unless the postcalibration was significantly different. Then, either the postcalibration was used or the pre- and postcalibrations were averaged. The decision to use only the postcalibration was based primarily on a comparison with nearby gauges during a time of high flow over linear bathymetry. In most cases, the current meter offsets were determined using the calibration curve for each channel of a given gauge and applied as a bias in volts (Figures D2 through D33). After plotting the time series in engineering units, however, further offsets of the velocities from zero were obvious for open frame channels 2711, 2731, and 2741 in the crest subarray, and for Marsh-McBirney channels 2701 and 2901 in the primary cross-shore subarray. These channels all measured cross-shore currents. The offsets appeared to be systematic throughout the duration of each time series, suggesting that a constant value applied to these data would be a satisfactory adjustment. To correct for these offsets, current velocities taken from these

channels during a calm period (6-10 October) were correlated against data from channels which did not appear to require further offsets. The y-intercept of the regression curve for each channel was the offset applied in meters per second to the current velocities. Correlation coefficient (r^2) values for these regressions ranged from 0.77 m/sec to 0.90 m/s. The greatest offset of -0.231 m/s was applied to channel 2741. New biases were computed from the changed offset using the following equation:

$$bias_{new} = bias_{orig.} + (\Delta offset / gain_{orig.}). \quad (1)$$

The open frame electromagnetic current meters posed a particular problem because of unanticipated biological fouling. Normally, the offset can be field determined by comparing data collected at orientations of 0 deg and 180 deg. However, the high wave activity during the last 2 weeks of the experiment prevented this check from being accomplished. An analysis performed on the current meter data from the crest and trough subarrays indicates an increase in the gains of the open frame sensors from the beginning to end of the experiment. This analysis is described in detail in the "Data Processing" section of Appendix E.

Comparison calibration plots for the open frame current meters and the Marsh-McBirney sensors, where the post-calibration differed from the pre-calibration, are shown in Figures D2 through D33.

Table D1
Calibration Data for Open Frame Electromagnetic Current Meters

Serial Number		Gauge Number	Pre-Cal. Gain (m/s)/V	Pre-Cal. Bias V	Cleaned Post-Cal. Gain (m/s)/V	Cleaned Post-Cal. Bias V	Post to Pre-Cal. Gain % Diff.	Post to Pre-Cal. Offset Diff. m/s	Post-Cal w/growth Gain (m/s)/V	Post-Cal w/growth Bias V	Calibration Used
OF6	X	2541	1.087	-0.022	1.084	-0.070	-0.276	0.052	1.374	-0.120	Pre-cal.
	Y	2542	1.083	0.071	1.076	-0.433	-0.646	0.543	1.366	-0.335	Pre-cal.
OF7	X	2711	1.051	-0.051	1.053	-0.172	0.190	0.127	1.396	-0.103	Offset
	Y	2712	1.075	0.131	1.072	0.401	-0.279	-0.289	1.416	0.347	Post-cal
OF9	X	2741	1.029	0.076	1.035	-1.081	0.583	1.197	1.393	-1.619	Offset.
	Y	2742	1.052	0.120	0.960	3.283	-8.745	-3.026	1.189	4.816	Pre-cal.
OF1	X	2721	1.085	0.091	1.079	0.070	-0.553	0.024	1.573	0.090	Pre-cal.
	Y	2722	1.058	-0.102	1.049	-0.021	-0.851	-0.086	1.581	-0.018	Pre-cal.
OF1	X	2731	1.062	0.192	1.068	0.359	0.565	-0.179	1.437	0.450	Offset.
	Y	2732	1.079	0.078	1.087	0.167	0.741	-0.098	1.576	0.098	Pre-cal.

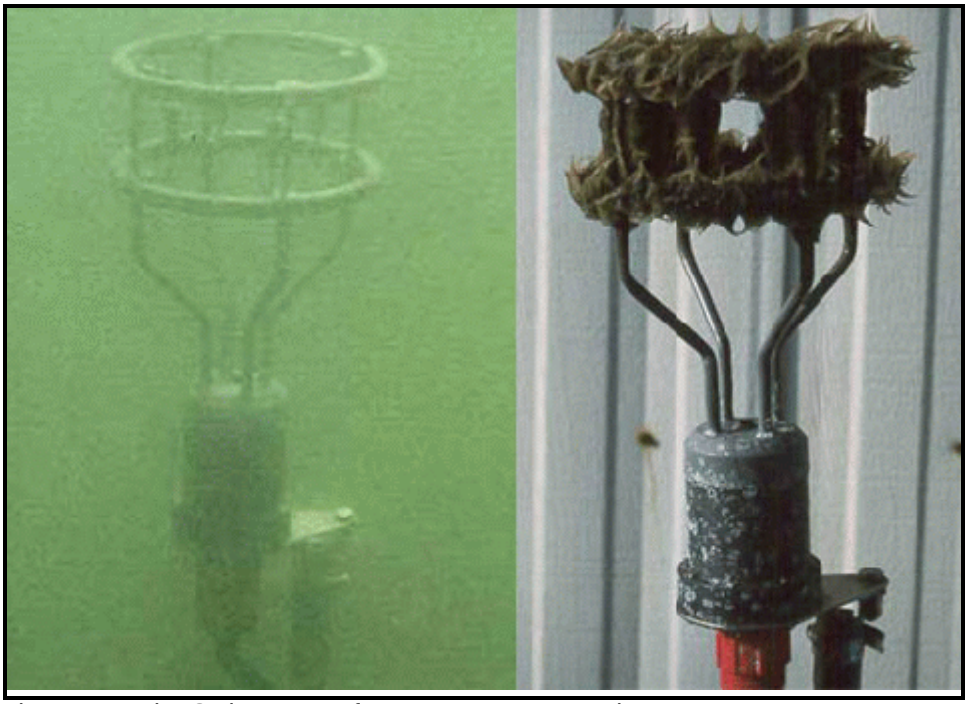

Figure D1. The Scripps' open frame current meter. The left image was taken after deployment, the right one after removal (note the biofouling)

Table D2
Calibration Data for Marsh-McBirney, Inc. Electromagnetic Current Meters

Serial Number	Gauge Number	Pre-cal.		Post-cal.		Post to Pre-cal.		Avg. Cal		Cal. Used
		Gain (m/s)/V	Bias V	Gain (m/s)/V	Bias V	Gain % Diff.	Offset Diff (m/s)	Gain (m/s)/V	Bias V	
S385 X	2321	0.823	0.009	0.907	0.009	10.207	-0.001	0.865	1.084	Average
Y	2322	1.038	0.008	1.139	0.008	9.730	-0.001	1.089	0.008	Average
S476 X	2331	1.125	-0.132	suspect						Pre-cal.
Y	2332	1.253	-0.006	calibration						Pre-cal.
S760 X	2341	1.267	-0.013	1.290	-0.012	1.815	-0.001			Pre-cal.
Y	2342	1.086	-0.015	1.095	-0.016	0.829	0.002			Pre-cal.
S761 X	2351	1.583	0.032	switch						Pre-cal.
Y	2352	1.581	0.012	to S762						Pre-cal.
S762 X	2351	1.099	-0.051	1.122	-0.013	2.093	-0.041			Pre-cal.
Y	2352	1.120	0.013	1.121	-0.004	0.089	0.019			Pre-cal.
S765 X	sled	1.154	0.023	1.177	-0.029	1.993	0.060			Pre-cal.
Y		1.335	0.046	1.356	0.067	1.573	-0.029			Pre-cal.
S766 X	sled	1.123	0.051	1.147	0.051	2.137	-0.002			Pre-cal.
Y		1.089	0.037	1.053	0.127	-3.306	-0.094			Pre-cal.
S837 X	sled	0.941	0.029	1.230	0.007	30.712	0.018			Post-cal.
Y		0.949	0.025	1.064	0.000	12.118	0.024			Post-cal.
S892 X	2311	1.277	-0.023	1.283	-0.015	0.470	-0.011			Pre-cal.
Y	2312	1.150	0.039	1.143	0.040	-0.609	-0.001			Pre-cal.
S972 X	2401	0.877	-0.299	1.064	-0.029	21.323	-0.231			Post-cal.
Y	2402	1.048	-0.069	1.075	-0.032	2.576	-0.038			Post-cal.
S1050 X	sled	0.652	-0.014	0.650	-0.006	-0.307	-0.005			Pre-cal.
Y		0.650	-0.014	0.649	-0.006	-0.154	-0.005			Pre-cal.
S1080 X	sled			1.093	-0.009					Post-cal.
Y				1.069	0.006					Post-cal.
S1013 X	2501	1.055	-0.001	1.054	0.026	-0.095	-0.028			Pre-cal.
Y	2502	1.080	0.031	1.033	0.030	-4.352	0.003	1.057	0.031	Average
S1015 X	2801	1.036	-0.023	suspect						Pre-cal.
Y	2802	1.056	-0.004	calibration						Pre-cal.
S1081 X	2301	1.000	0.002	1.010	0.000	1.000	0.002			Pre-cal.
Y	2302	1.029	0.001	1.039	0.015	0.972	-0.015			Pre-cal.
S1082 X	2201	1.013	-0.005	1.012	-0.003	-0.099	-0.002			Pre-cal.
Y	2202	1.072	-0.193	1.065	-0.133	-0.653	-0.065			Pre-cal.
S1083 X	2101	1.023	-0.013	1.018	-0.008	-0.489	-0.005			Pre-cal.
Y	2102	1.083	-0.012	1.053	-0.010	-2.770	-0.003			Pre-cal.
S1084 X	2901	1.013	-0.011							Offset
Y	2902	1.028	-0.052	1.040	-0.033	1.167	-0.019			Pre-cal.
S1012 X	2701	1.044	-0.029	1.049	-0.038	0.479	-0.010			Offset
Y	2702	1.089	-0.017	1.091	-0.021	0.184	-0.003			Pre-cal.
S1011 X	2601	1.045	0.037	gauge						Pre-cal.
Y	2602	1.051	0.052	destroyed						Pre-cal.

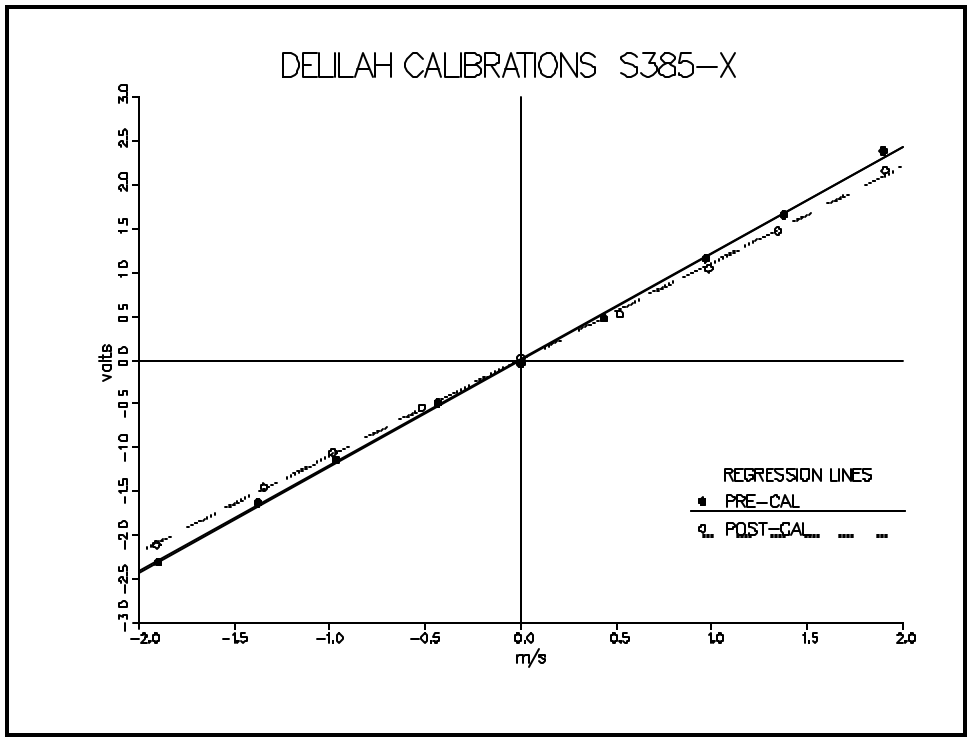

Figure D2. Calibration data for S385-X. Average calibration used

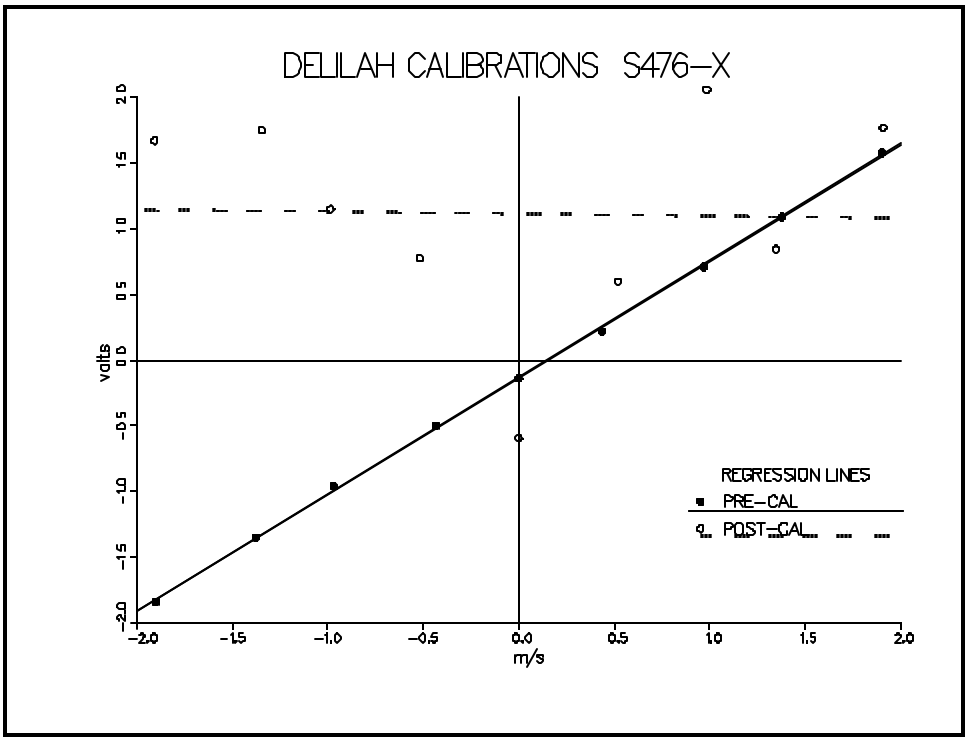

Figure D4. Calibration data for S476-X. Pre-calibration used

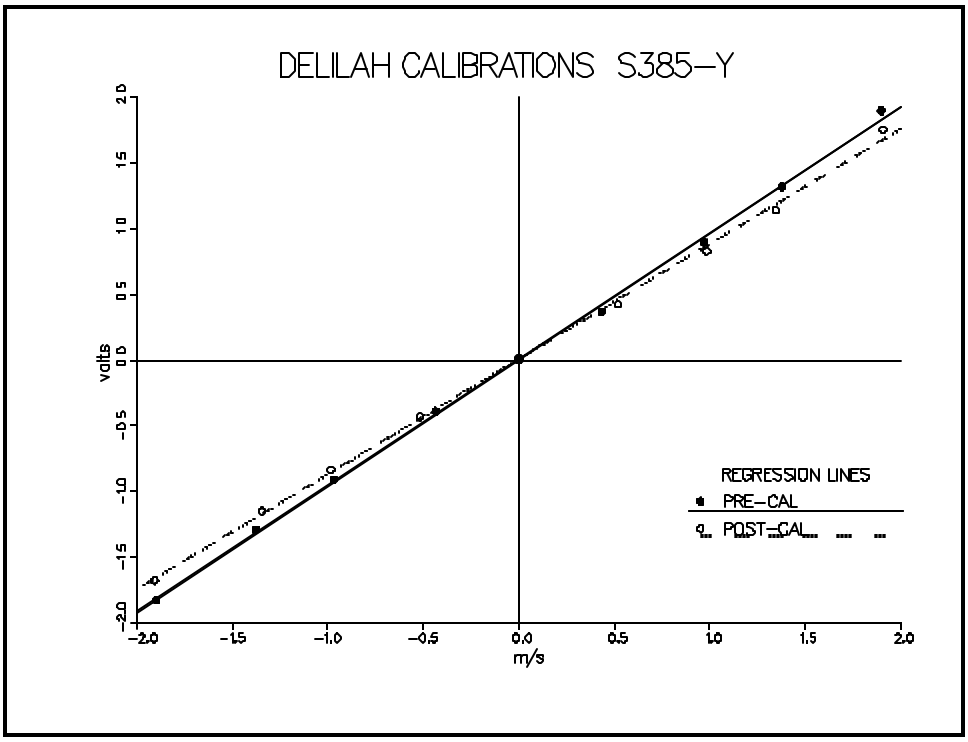

Figure D3. Calibration data for S385-Y. Average calibration used

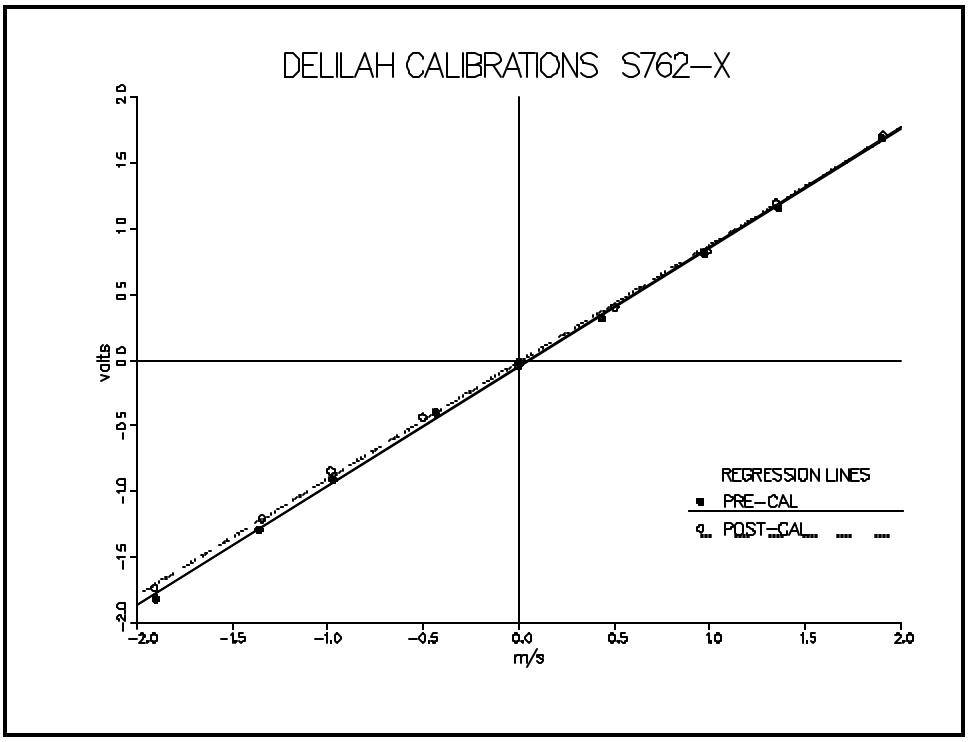

Figure D6. Calibration data for S762-X. Pre-calibration used

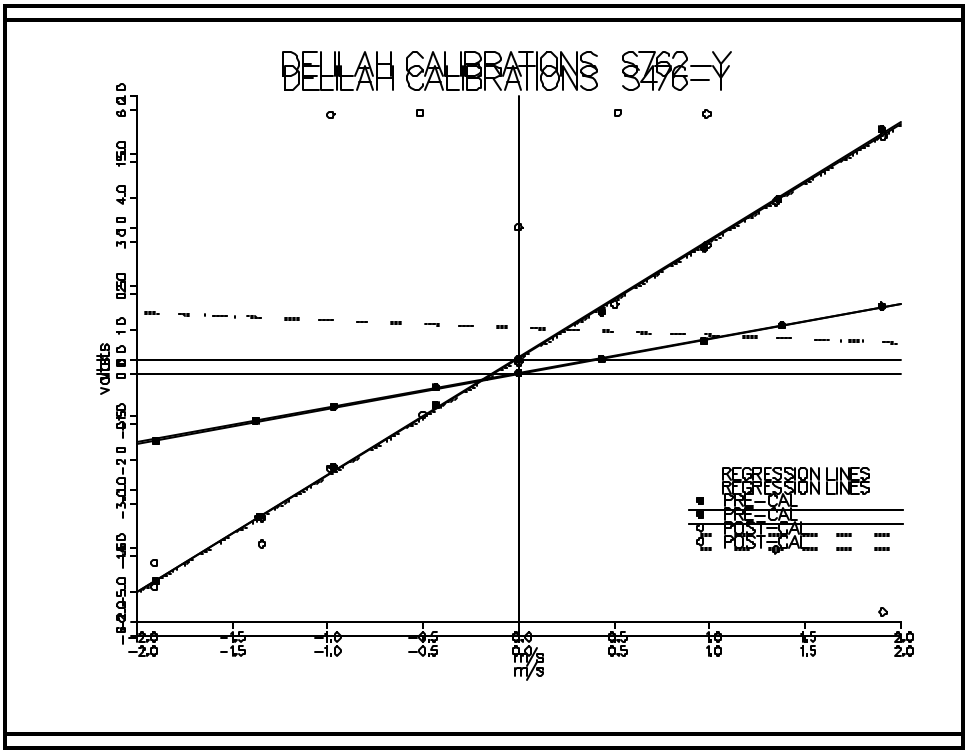

Figure D7. Calibration data for S476-Y. Pre-calibration used

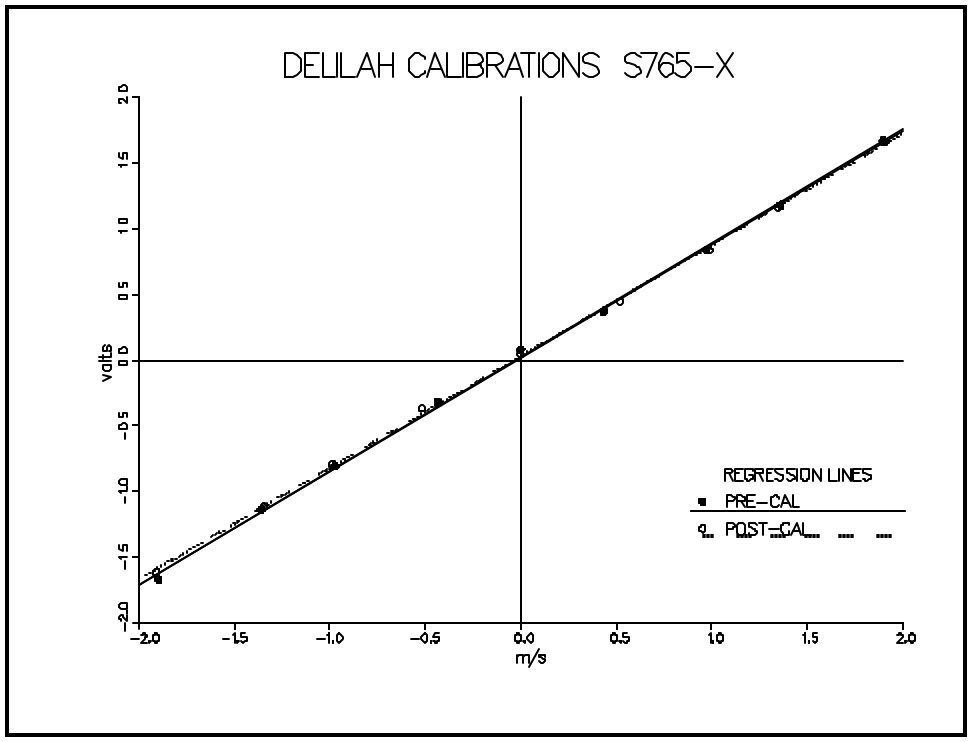

Figure D8. Calibration data for S765-X. Pre-calibration used

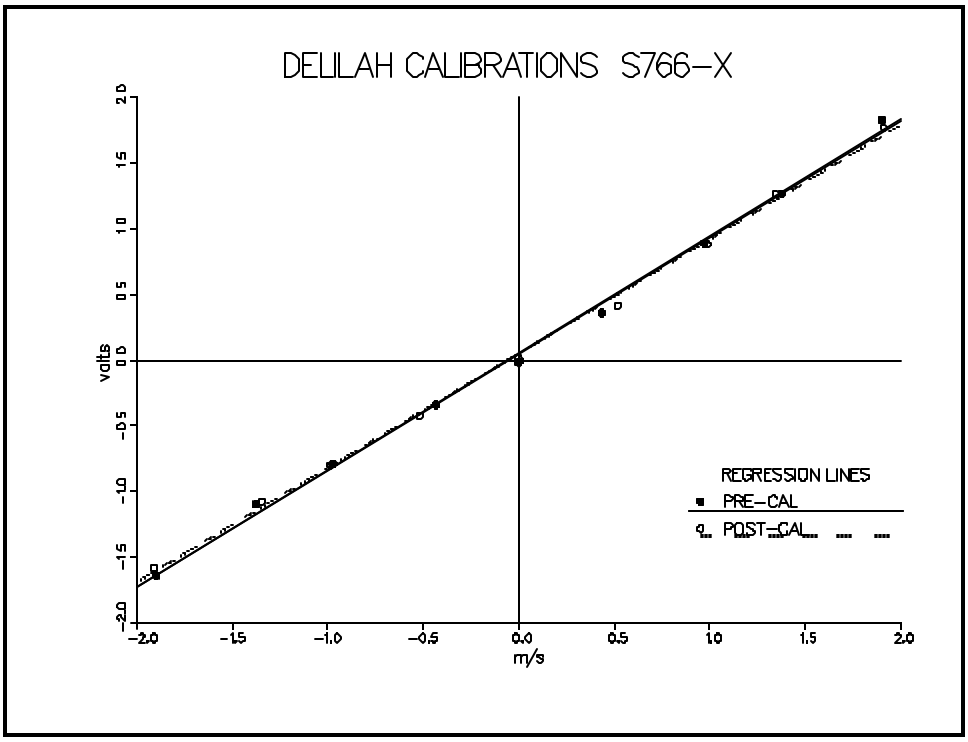

Figure D10. Calibration data for S766-X. Pre-calibration used

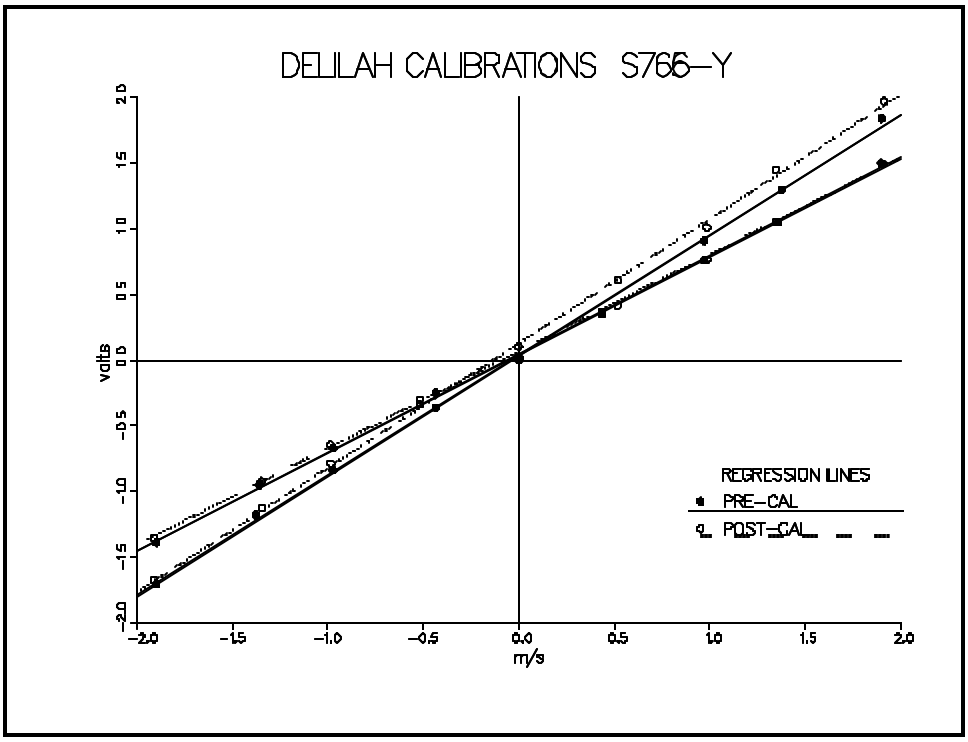

Figure D11. Calibration data for S766-Y. Pre-calibration used

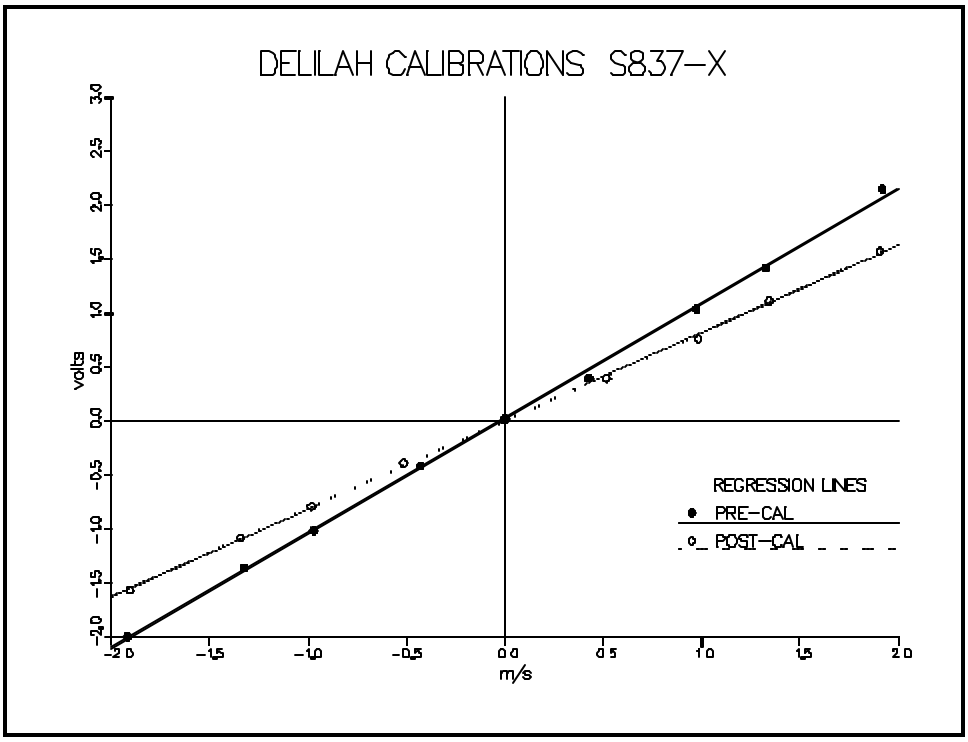

Figure D12. Calibration data for S837-X. Post-calibration used

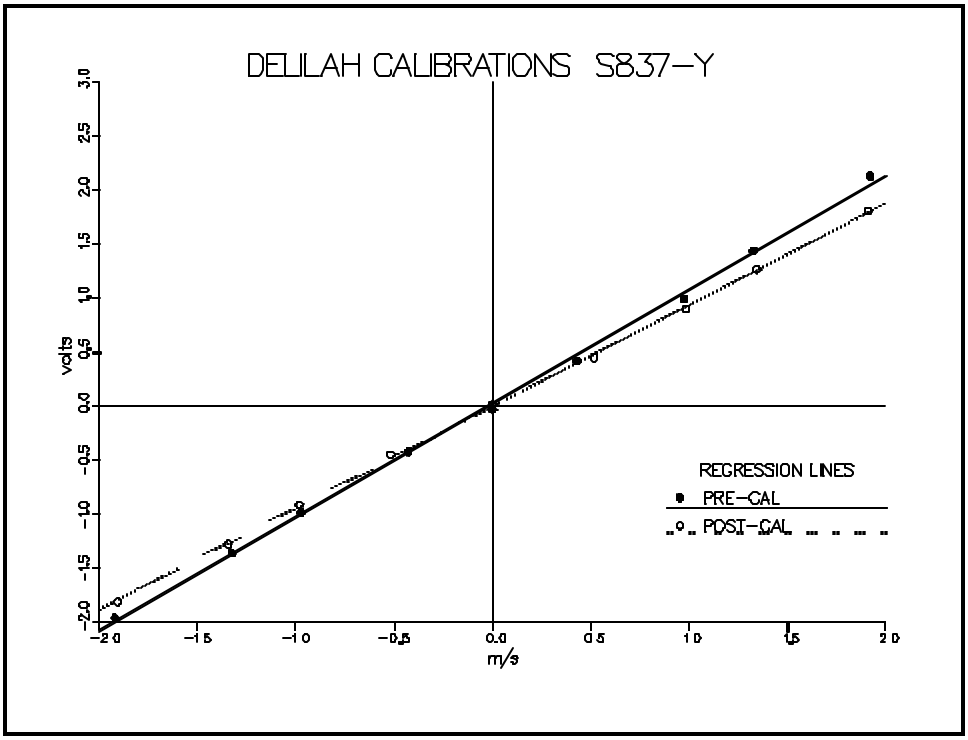

Figure D13. Calibration data for S837-Y. Post-calibration used

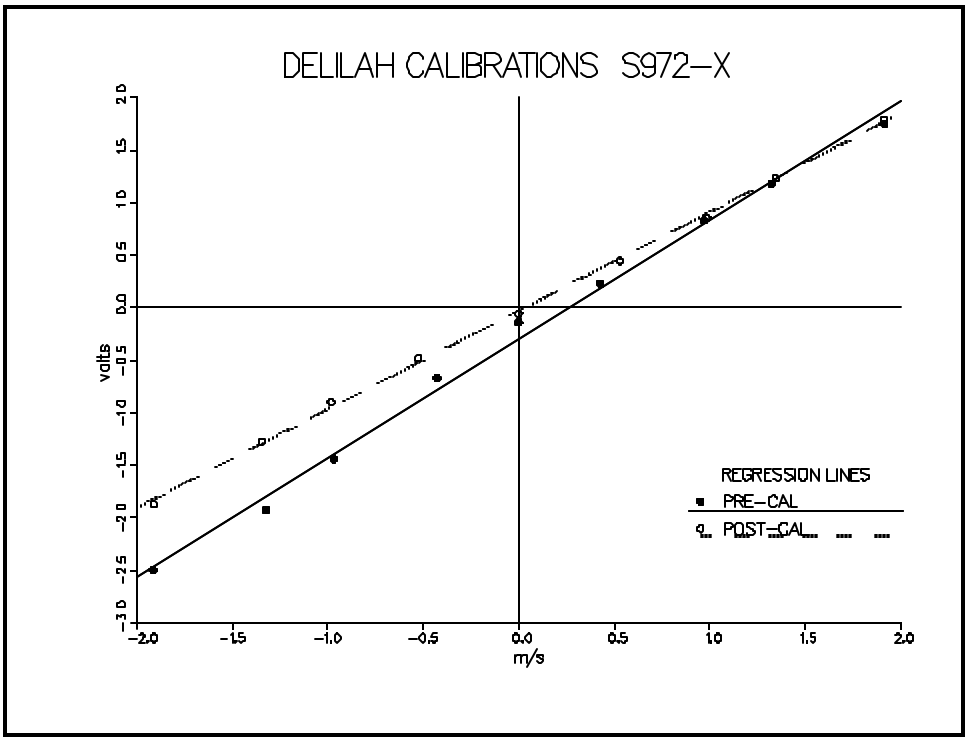

Figure D14. Calibration data for S972-X. Post-calibration used

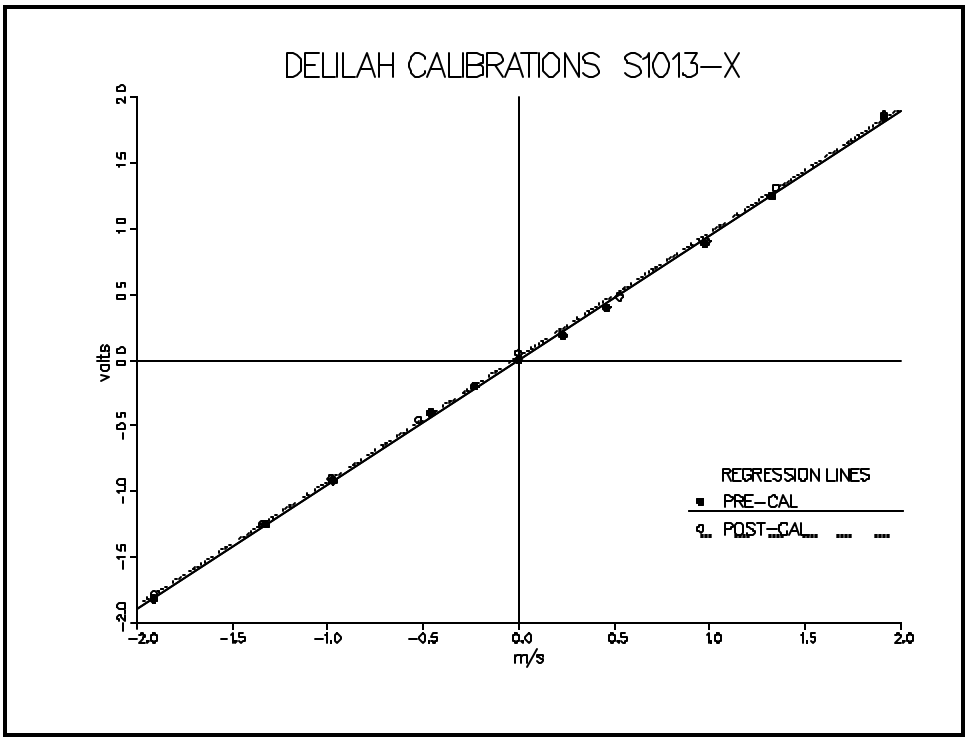

Figure D16. Calibration data for S1013-x. Pre-calibration used

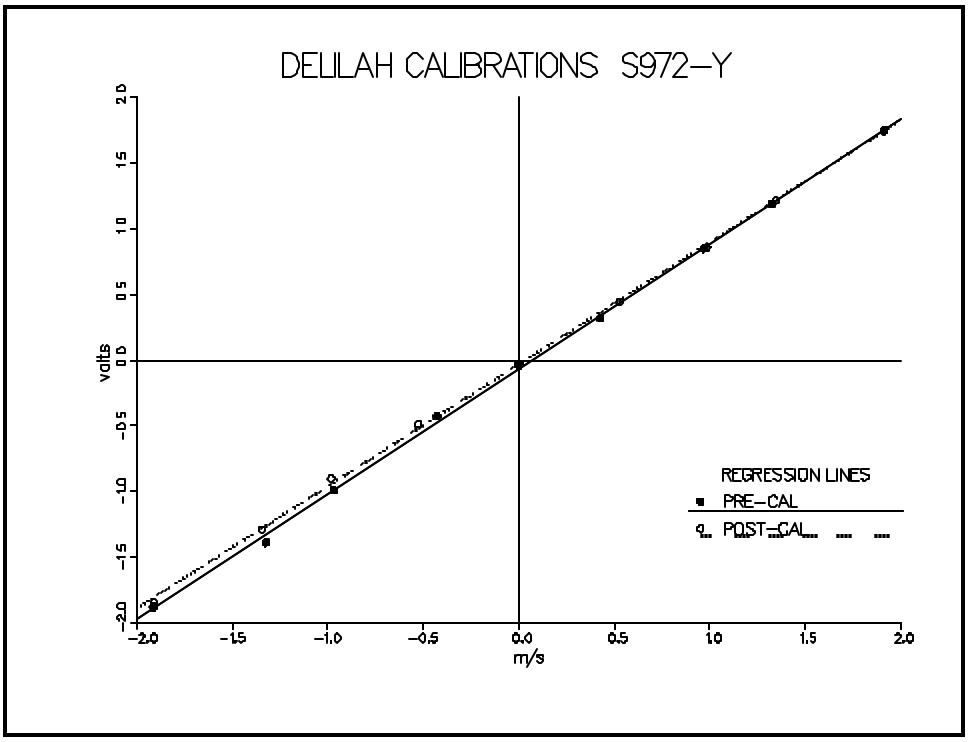

Figure D15. Calibration data for S972-Y. Post-calibration used

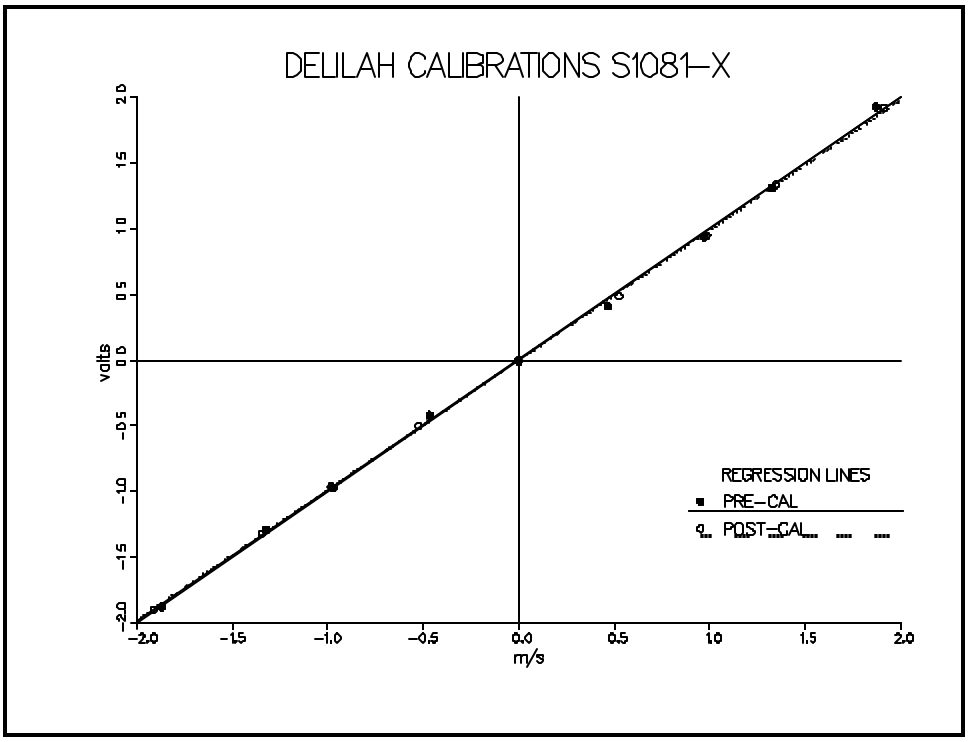

Figure D18. Calibration data for S1081-X. Pre-calibration used

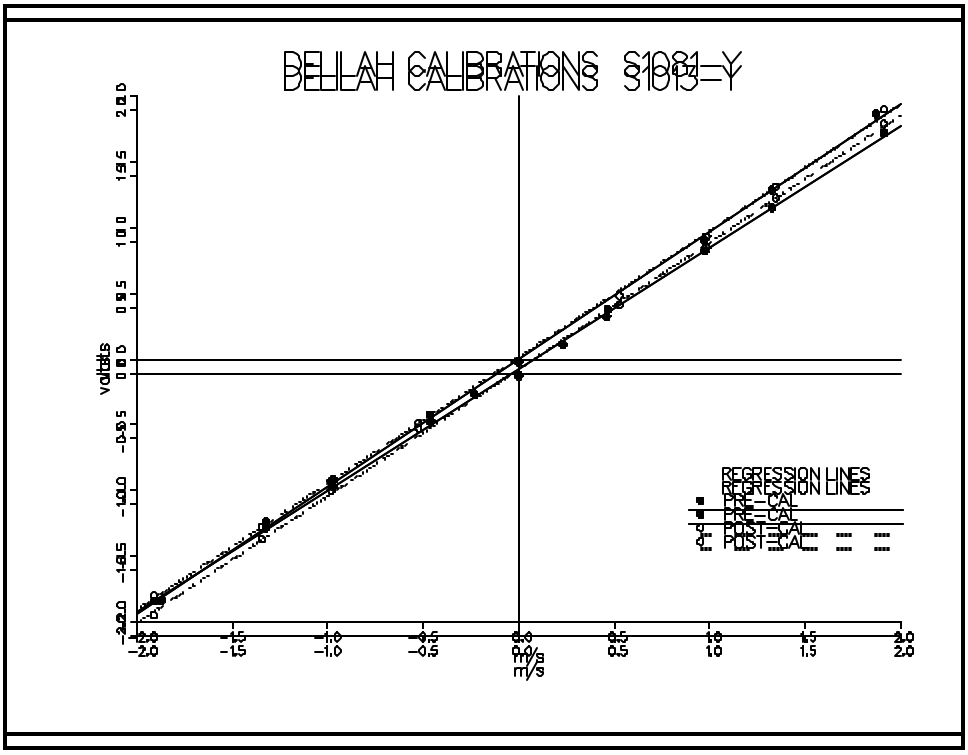

Figure D19. Calibration data for S1083-Y. Average calibration used

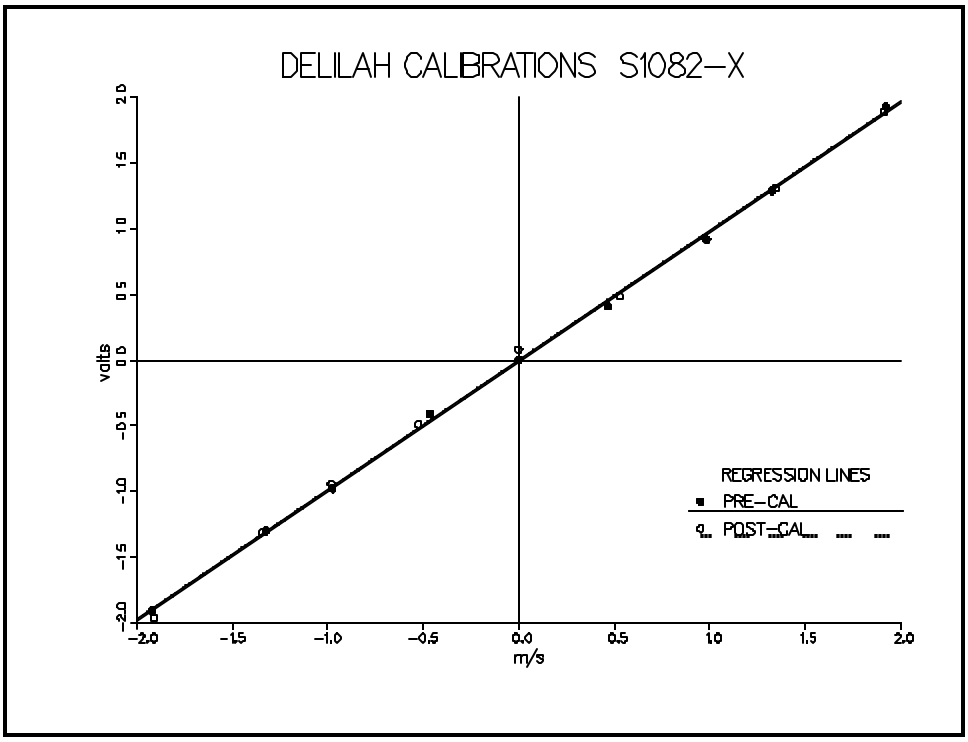

Figure D20. Calibration data for S1082-X. Pre-calibration used

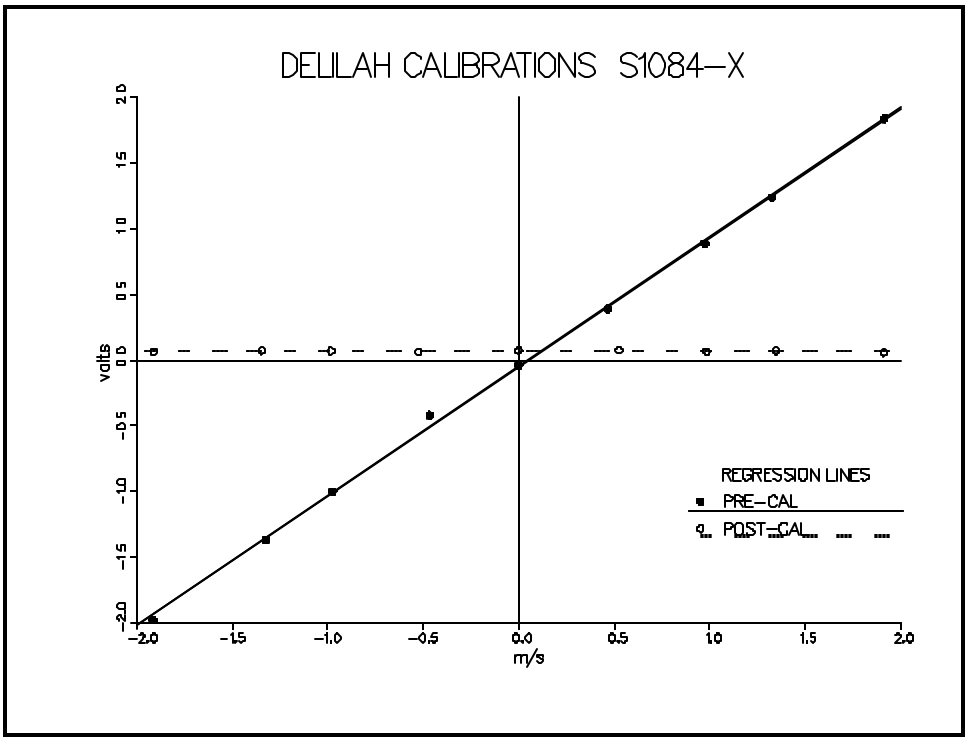

Figure D22. Calibration data for S1084-X. Pre-calibration used plus offset

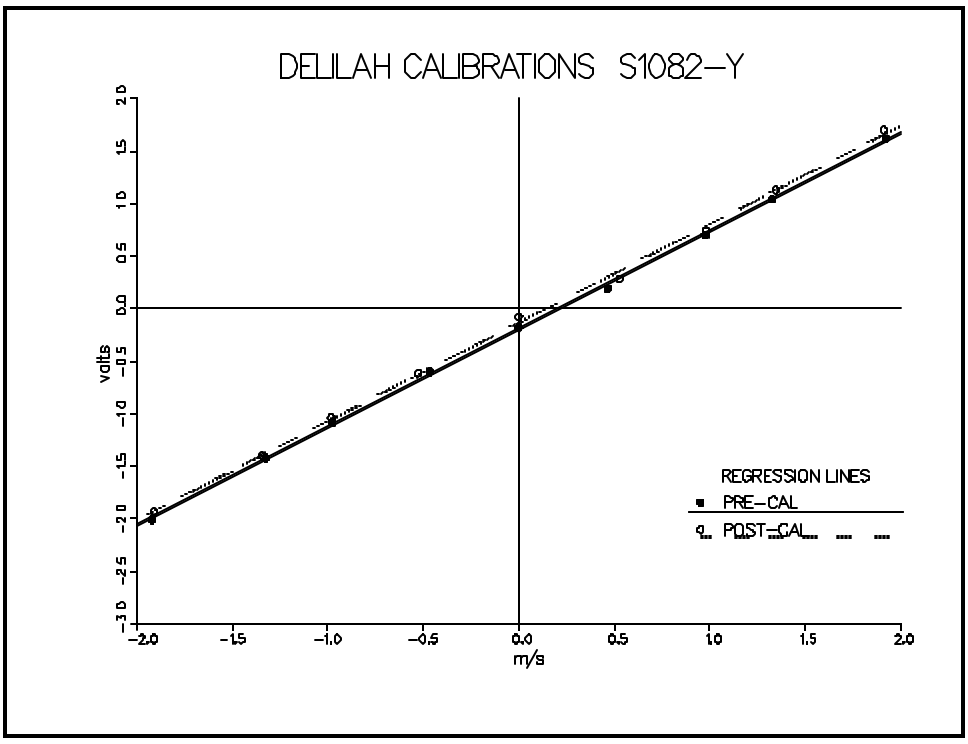

Figure D21. Calibration data for S1082-Y. Pre-calibration used

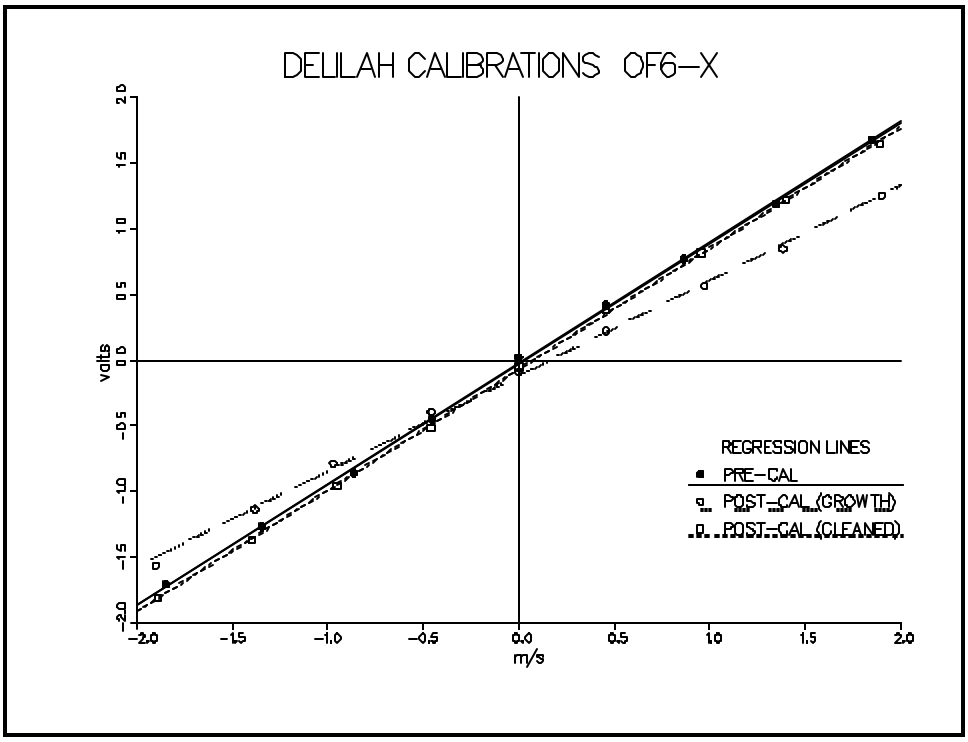

Figure D24. Calibration data for OF6-X. Pre-calibration used

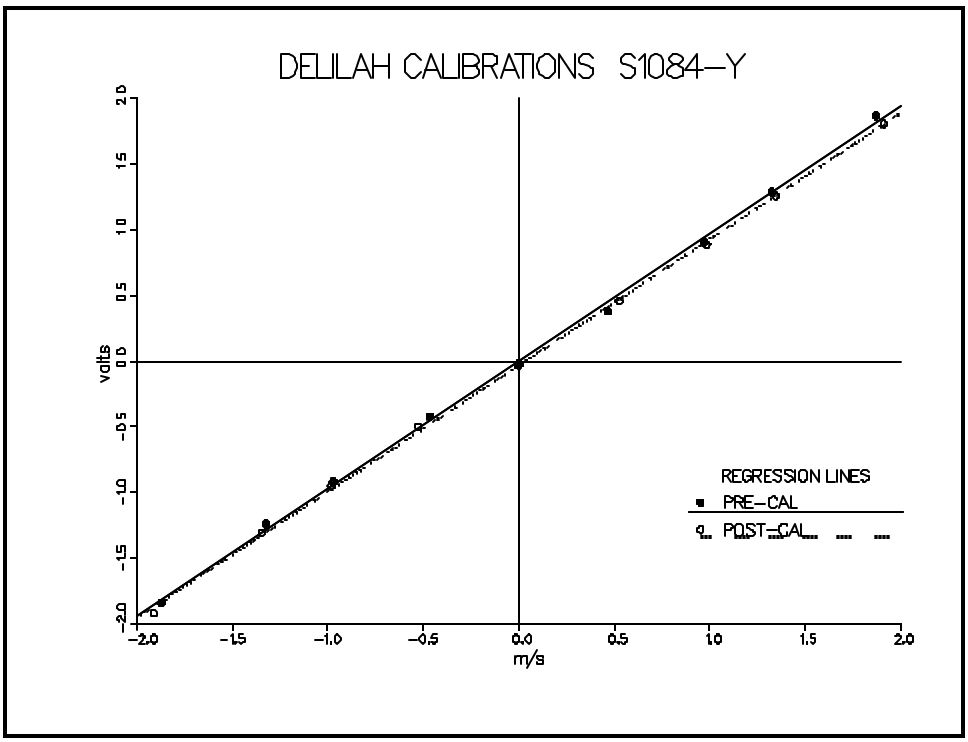

Figure D23. Calibration data for S1084-Y. Pre-calibration used

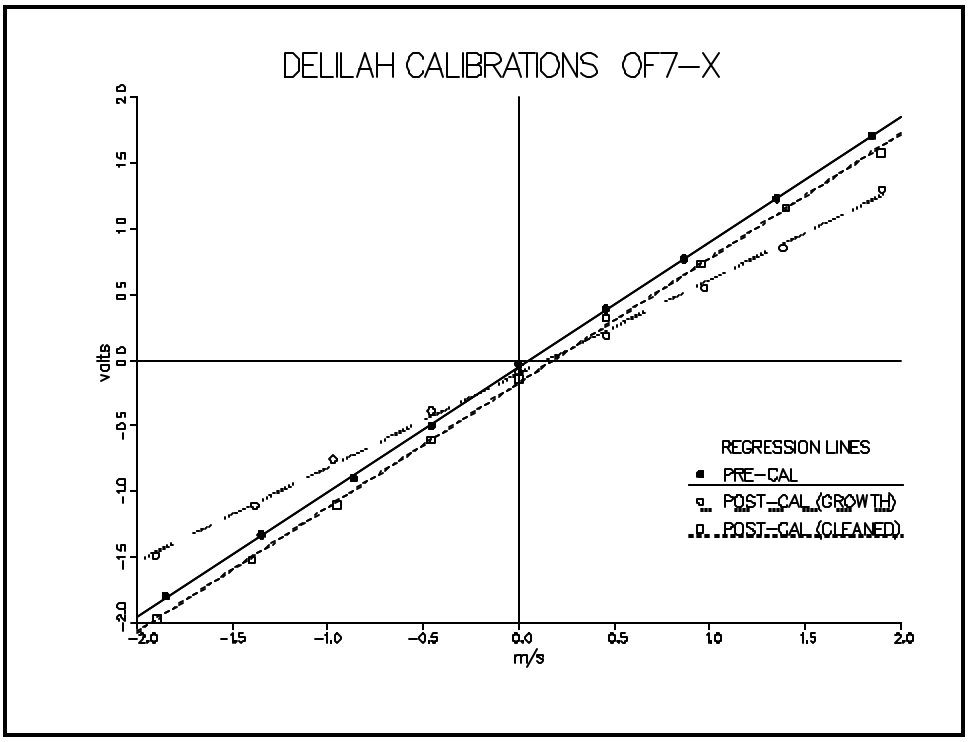

Figure D26. Calibration data for OF7-X. Pre-calibration used

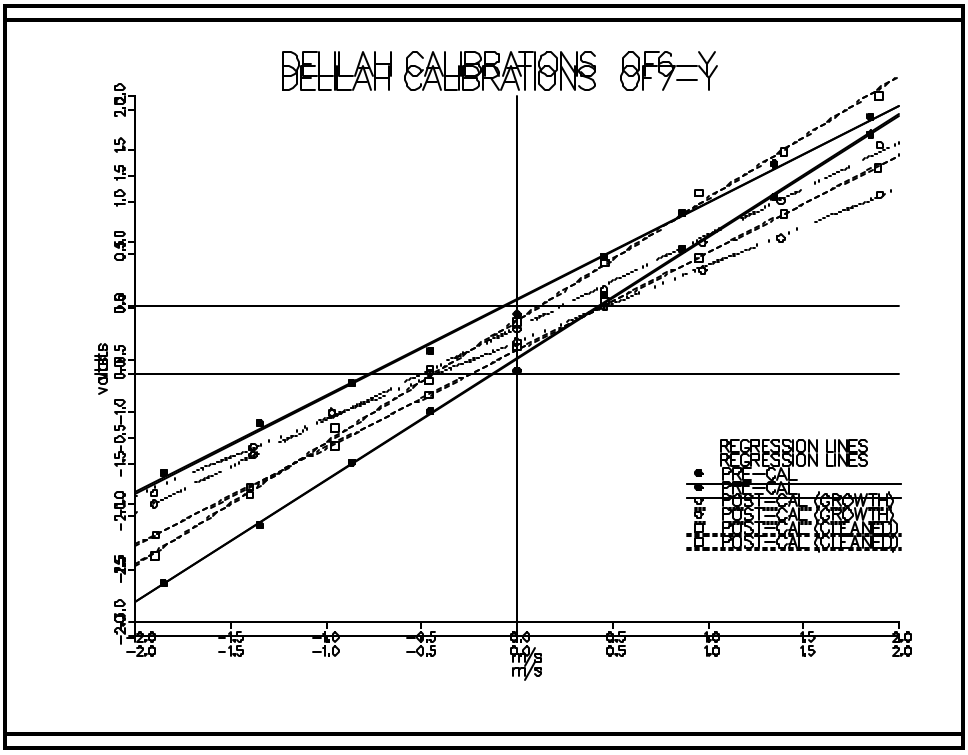

Figure D27. Calibration data for OF7-Y. CLEANED post-calibration used

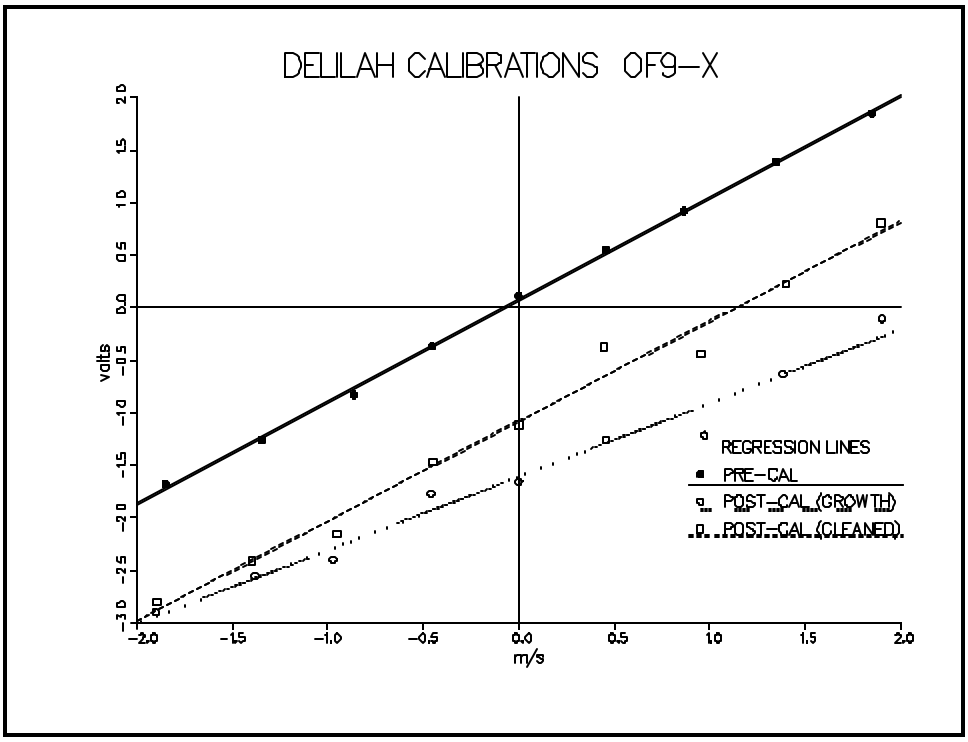

Figure D28. Calibration data for OF9-X. Pre-calibration used

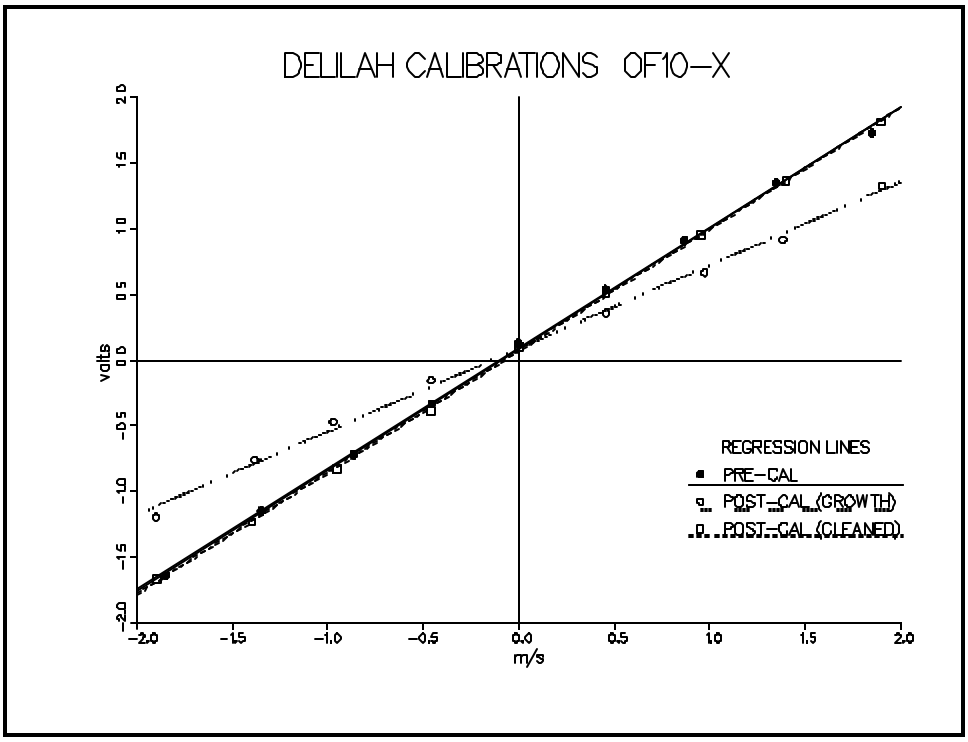

Figure D30. Calibration data for OF10-X. Pre-calibration used

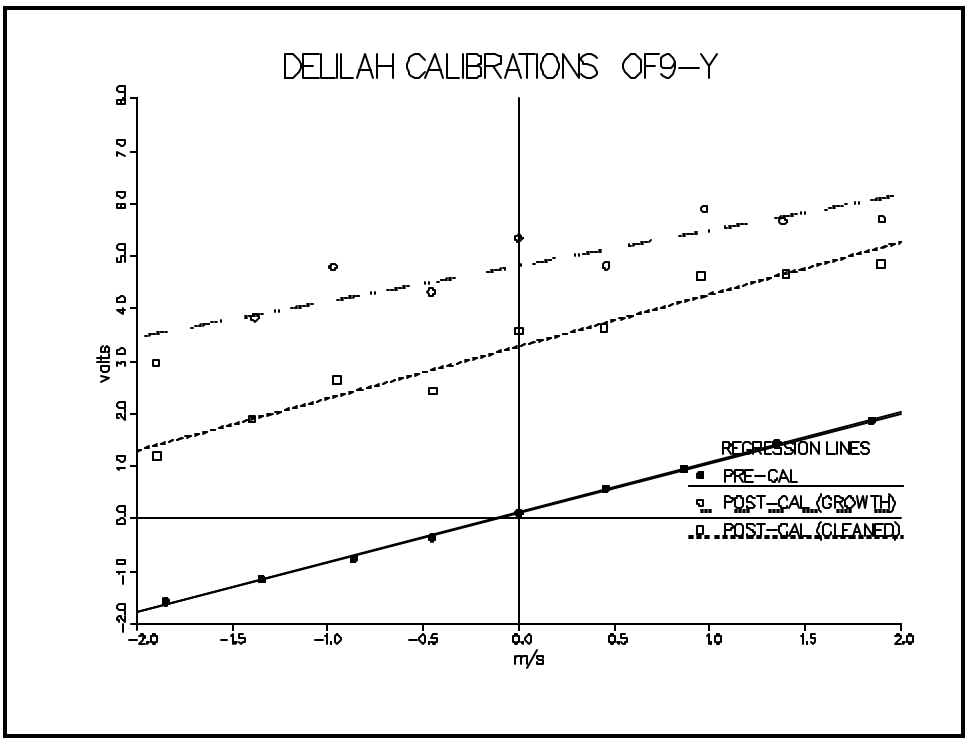

Figure D29. Calibration data for OF9-Y. Pre-calibration used

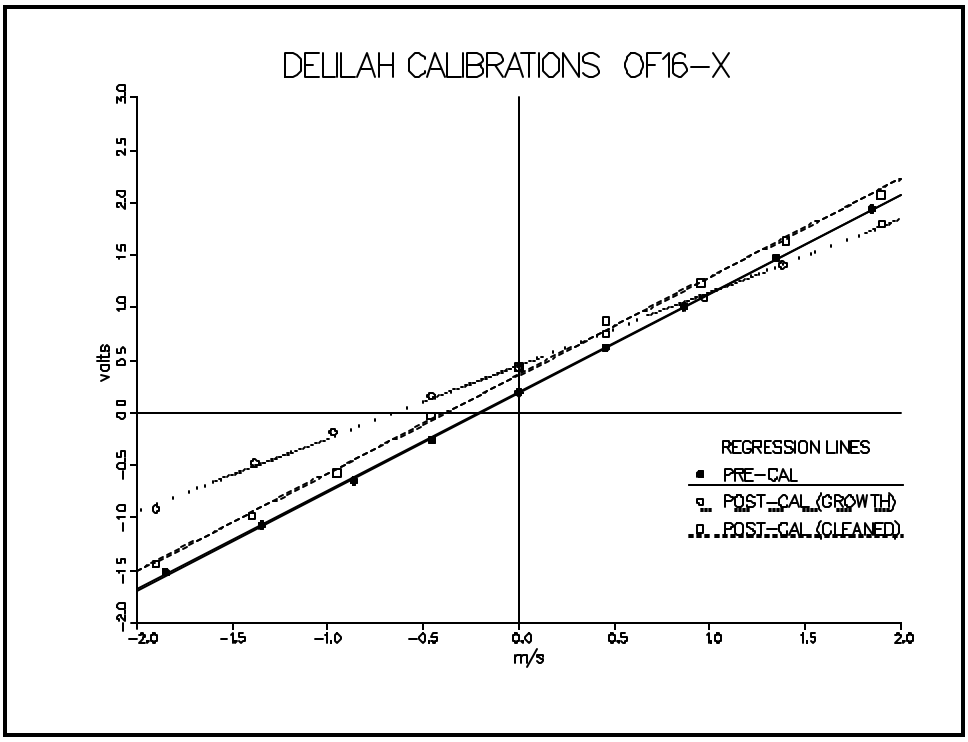

Figure D32. Calibration data for OF16-X. Pre-calibration used

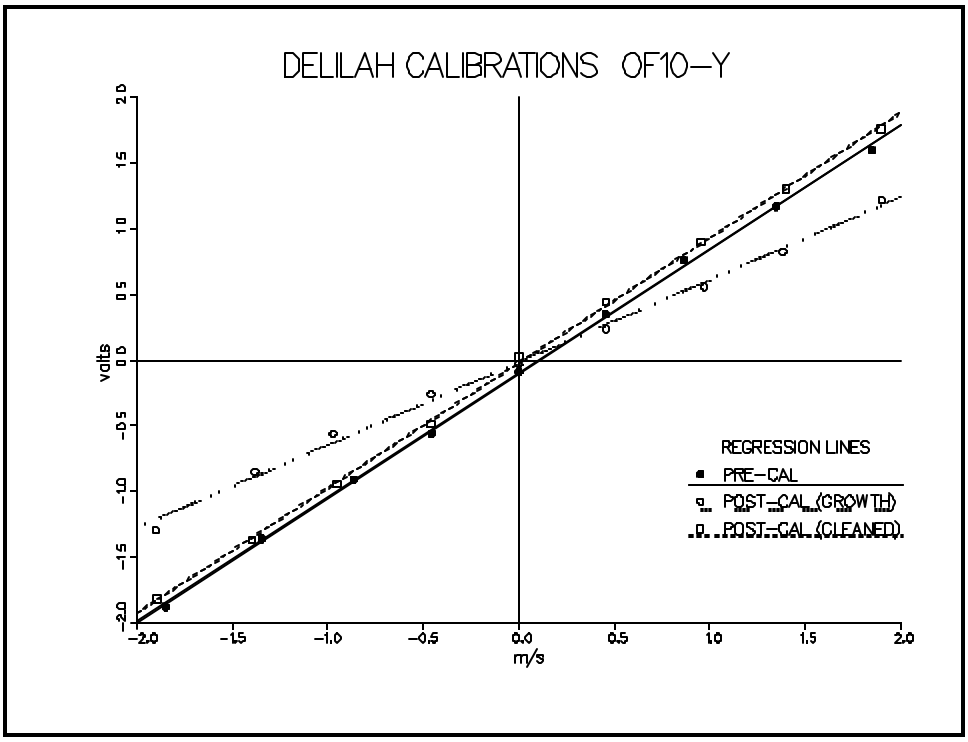

Figure D31. Calibration data for OF10-Y. Pre-calibration used

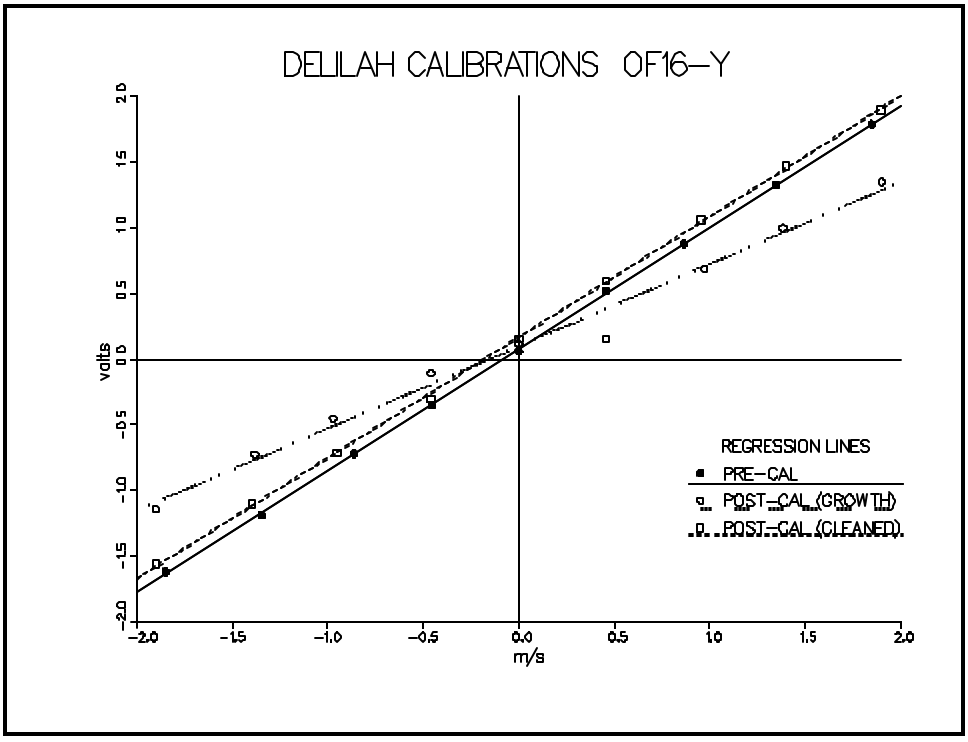

Figure D33. Calibration data for OF16-Y. Pre-calibration used